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DESCRIPTION AND LIFE HISTORY OF *PEDALIODES ZINGARA*, A NEW SATYRINE SPECIES FROM COLOMBIA (NYMPHALIDAE)

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ABSTRACT. We describe the immature stages and the adult (male and female) of *Pedaliodes zingara*, a new species of pronophiline satyrine from the Cordillera Occidental of Colombia. Bionomics of the species and its possible congeneric relationships, as well as its breeding potential and pattern of egg production, are discussed.

Additional key words: biogeography, life cycle, Neotropics, Pronophilini, South America.

RESUMEN. Se describe los estadios inmaduros y el adulto (macho y hembra) de *Pedaliodes zingara*, nueva especie de satírido pronofilino de la Cordillera Occidental de Colombia. Se aporta información bionómica sobre la especie y se discute sobre las posibles relaciones con sus congéneres, su potencial reproductivo y su patrón de producción de huevos.

Palabras clave adicionales: biogeografía, ciclo de vida, Neotrópico, Pronophilini, Sudamérica.

During the last four decades, the Neotropical Satyrinae have once again drawn the attention of lepidopterists. The systematics of the subfamily underwent substantial changes (Forster 1964, Miller 1968, Viloria in press), and a considerable number of descriptions of recently discovered taxa has been published. However, the fundamental knowledge of the biology of this group of Lepidoptera is limited due to the scarcity of hostplant identifications and developmental observations (Viloria in press, Beccaloni et al. in press). The butterflies of the genus *Pedaliodes* Butler may well illustrate these assertions. They are, within the Satyrinae, a prominent focus of current taxonomical progress (e.g., Adams 1986, Pyrcz & Viloria 1999, Viloria & Pyrcz 2000), but their biology is so poorly studied that not even one complete life cycle has hitherto been described (see discussion).

Sometimes morphological divergences among butterfly species are more marked on immature stages than in adults. Such appears to be the case in some nymphalid genera like *Cissia* (especially the '*confusa*' group, sensu Singer et al. 1983), *Adelpha* (Aiello 1984) and *Calisto* (Sourakov 1996, 1999), in which the knowledge of life cycles has contributed to the determination of taxa. Yet, it is not known whether those species of *Pedaliodes* that are difficult to separate by features of wing pattern or male genitalia show substantial differences in their early stages. Furthermore, attempts to reveal the phylogenetics of *Pedaliodes* are entirely based on adult morphology, whose character sets are limited compared with the apparent species richness of the clade (Viloria 1998). In other words, there are so many species, so few useful characters, and so little variation within most of these characters, that one wonders whether it is possible to get a unique matrix representing the character states for each and every known species of *Pedaliodes*. Should it be feasible to produce a reliable phylogeny based on adult characters, then it would necessarily be just a preliminary one, as the discovery of additional (perhaps unexpected, and certainly new) features from the life history of these insects might render another scenario. Therefore, general interest in the study of the immature stages of the Neotropical Satyrinae is growing (see for instance, Freitas 2002, 2003).

Research on the biology of the insect fauna associated with montane woody bamboos of the genus *Chusquea*, conducted by the senior author in the Western and Central ranges of the Colombian Andes, has for the first time yielded accurate information on the life cycle of several species of butterflies (Morphinae, Satyrinae) and skippers (Hesperiidae) (Heredia & Alvarez-López in press, and unpubl.). One of the satyrines whose cycle was observed entirely from egg to imago was recognized as an undescribed species of *Pedaliodes* Butler, which was already known to one of us (ALV) by old museum specimens. Both the species and its life history are described here.

MATERIALS AND METHODS

Standard systematic work was based on individuals collected as adults and laboratory reared adults from eggs and larvae picked up in the type locality (now deposited in the collections of the Museo de Entomología [MEUV[, Universidad del Valle, Cali, Colombia, and in the private collection of M. Dolores

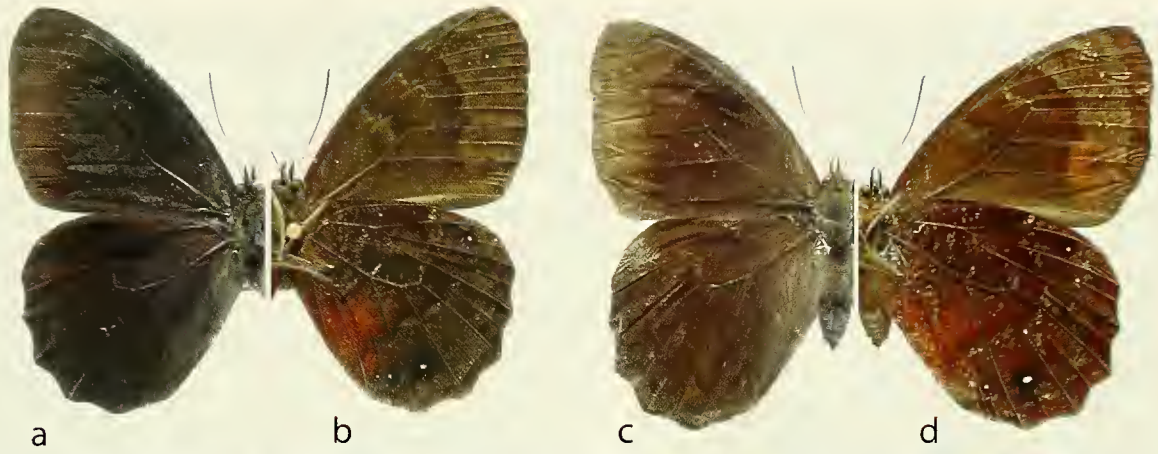

FIG. 1. Adults of *Pedaliodes zingara*; **a,** Dorsal view of male Holotype, Zíngara, Municipio de Cali, Departamento del Valle del Cauca. Colombia, 2000 m, 03°32′23″N, 76°36′16″W, adult emergence date 16 October 1999, M. D. Heredia (MEUV); **b,** The same, ventral view; **c,** Dorsal view of female paratype, same locality, adult emergence date 13 October 1999, M. D. Heredia (MEUV); **d,** The same, ventral view.

Heredia (MDH), Cali), and on specimens from the entomological collections of the Natural History Museum, London, UK (BMNH), the State Zoological Collections of Munich, Germany (ZSBS), the Instituto de Ciencias Naturales, Universidad Nacional de Colombia, Bogotá (ICN), and the private collection of the Constantino family (CFC) in Cali.

The type locality, Finca Zíngara, is a small farm within a wider study area (1900–2200 m), which is located 4 km north of "El Dieciocho" (km 18 of the road from Cali to Buenaventura) on the way to Pavas, eastern slope of the Cordillera Occidental, Corregimiento de La Elvira, Municipio de Cali, Departamento del Valle, Colombia. It is included in the "lower montane moist forest" of Holdridge's Life Zones system (Espinal & Montenegro 1963). The local vegetation is composed by cloud forest patches, more or less disturbed, surrounded by suburban land properties for recreational and/or low intensity forestry, dairy, and agricultural activities.

Life history data were gathered through direct observation of adult females and larvae in captivity. Larvae and eggs independently obtained by visually searching the bamboo (*Chusquea*) clumps at the type locality, were selected and transferred to rearing bottles in the laboratory in Cali. Larvae were bred at controlled room temperature of 20–24°C, with a photoperiod of 12:12. Hostplant stock was kept fresh up to two weeks wrapped in damp paper towels in a refrigerator. Larval food was replaced daily, and observations were processed on the same basis. Adults in captivity were fed ad libitum a 20% honey-water solution three times per day. Oviposition was induced by placing the female in a plastic cage (14 × 16 cm) together with fresh *Chusquea* stems and leaves.

Early stage individuals were described and measured in vivo, in each case just after hatching or molt, using a stereomicroscope (15–20×) equipped with reticules of 0.1 and 0.05 mm. Adults, epicrania and exuviae of the pupae were preserved in the collection of one of the authors (MDH). Specimens of the hostplants were deposited in the Herbarium of the Universidad del Valle, in Cali.

SYSTEMATICS

Pedaliodes zingara Heredia & Viloria, new species

(Figs. 1, 2, 3, 4, 5)

[*Pedaliodes* sp. nov. 2 Viloria MS]; Viloria, 1998:297–298.
[*Pedaliodes phrasiclea* Crose-Smith; Pyrcz, 1999:355, 356; Viloria & Pyrcz, 2000:97; Viloria et al., 2001:40 (misidentifications, in part)]

Diagnosis. *Pedaliodes zingara* could be confused with *P. phrasiclea* Grose-Smith, 1900, *P. pisonia* (Hewitson, 1862), and *P. canela* Pyrcz & Viloria, 1999, the latter recently recorded from the Pacific slope of the Western Andes. *Pedaliodes canela* flies above 2000 m and is similar in size to *P. zingara*. However, *P. canela* does not have the ventral reddish suffusion on the anal region of the hindwing. On the other hand, *P. pisonia* shows a similar wing pattern, but it is smaller than *P. zingara*, and it is almost certainly restricted to Venezuela (Viloria et al. 2001). This new taxon has been confidently recorded on the Western Andes, but there are two dubious museum records from the Eastern Andes in the Bogotá area. Adults fly between 1800 and 2200 m, which means that it can overlap altitudinally with *P. phrasiclea*, which also ranges in the Western Andes between 1200 and 1800 m, and often bears a reddish suffusion on the anal region of the hindwing verso. Nevertheless, male genitalia of these two species show

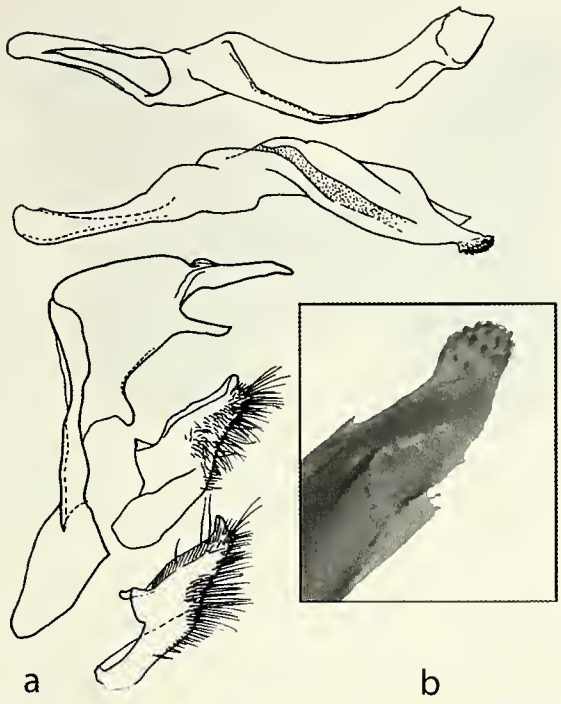

FIG. 2. **a,** Male genitalic armature of *Pedaliodes zingara*, new species. Valvae (right) and aedeagus (above) have been removed from their original positions to allow more informative views. Aedeagus has been drawn in dorsal (above) and lateral view (below); **b,** Close up of the spiny process of the apical extremity of aedeagus.

clear differences in the caudal extremity of the aedeagus, in the shape of the saccus, in the junctions of the uncus and the tegumen (which has a slight prominence in *P. zingara*), and in the distal process of the valvae.

Description. Male (Figs. 1a, b): FWL 30.4 mm (n = 4, SD = 1.03). Head: Antenna reaching to half costa, brown with beige scales dusted along dorsal and ventral surfaces, club gradually formed, cylindrical; eyes dark brown with black hairs; palpi externally with light band at base, internally with sparse light-brown hairs, black hairs distally. Thorax: dark brown, dense brown hairs laterally; second and third pair of legs brown, with reddish hairs only on femorae. Abdomen: brown, slightly paler ventrally. Wings: Forewing outer margin smooth, slightly scalloped in hindwing. Both wings with some beige scales on the fringes. Dorsally dark and bright brown, forewing postmedial and marginal areas slightly paler. Hindwing hairy on anal region and discal cell. Androconial patches similar to those of *P. canela* (Fig. 4). Forewing ventral surface dark brown, lighter band from postmedial region to outer margin, chestnut on apex and subapical region; lighter brown on two portions of discal cell (distal and medial), as well as on anal margin; 2 to 3 minute submarginal white dots in cells R5, M1 and M2, respectively. Hindwing ventral surface dark brown, lighter band from postmedial region to outer margin, which is chestnut; submarginal dots in cells Rs, Cu1 (larger, circled with black) one each, and two in Cu2; anal region with a reddish suffusion, which reachs vein Cu2 in its wider portion. Armature of the genitalia illustrated in Fig. 2.

Female (Figs. 1c, d): FWL 31.3 mm (n = 4, SD = 1.11). Similar to male but larger; background ventral color lighter and more chestnut than in male; forewing bearing a reddish area on cells Cu1 and Cu2; six submarginal white dots (often circled with black, especially Cu1), from cells R4 to Cu1 (one each). Hindwing always with white dots in cells Rs and Cu1, but sometimes only one dot or none in Cu2.

Types. Holotype. ♂: Zíngara, Municipio de Cali, Departamento del Valle del Cauca, Colombia, 2000 m, 03°32′23″N, 76°36′16″W, laboratory reared from first instar larva, adult emergence date 16 October 1999, genitalic dissection No. 8, M. D. Heredia; in the collection of the Museo de Entomología Universidad del Valle (MEUV).

Paratypes. All from Colombia: 1 ♀, same locality as holotype, adult emergence date 13 October 1999, M. D. Heredia; 1 ♂, same locality, wild-caught 24 February 2002 , M. D. Heredia; 1 ♀, same locality, adult emergence date 8 December 1999, M. D. Heredia [MEUV]; 1 ♂, same locality, wild-caught 22 September 2002, M. D. Heredia; 1 ♀, same locality, adult emergence date 18 October 1999, M. D. Heredia; 1 ♀, same locality, adult emergence date 26 December 1999, M. D. Heredia; 1 ♂, Vereda El Otoño, Municipio de Cali, 1800 m, Wild-caught, 25 January 1998, M. D. Heredia [MDH]; 1 ♂, Western Cordillera, Alto de Las Cruces, 2200 m, 10 October 1908, A. H. Fassl, JB [BMNH]; 1 ♂, Kustencordillera, Cali, 1000 m, 16 July 1967, Denhez [ZSBS]; 1 ♂, Km 18, Municipio de Cali, 1800 m, June 1985, L. M. Constantino [CFC]; 2 ♂, Risaralda, Mistrató, San Antonio de Chami, W de Alto Pisones-Caguadas, 1500 m, 17 April 1983, G. Andrade (CAC 4511, 4613); 1 ♂, Risaralda, Pereira, La Florida, La Suiza, Parque de Ucumari, 2300m, 28 June 1994, G. Andrade C. (GAC-6024, ICNL-11905); 1 ♂, Risaralda, Mistrató-Alt. Pisones, 1450m, camino a Río Currumai, 31 May 1992, G. Andrade C. (ICNL-8925); 1 ♂, same data, 1850m (ICNL-14047); 1 ♀, same data, 1300 m, 1 June 1992 (ICNL-8959); 1 ♂, Quindío, Filandia, Vda. El Roble, Finca La Popa, Casa Bremen, CRQ Int. del bosque, 2000 m, 20–22 June 1999, Diego Tobar (DIEG-1475, ICN-MHN-L-17172); 1 ♂, same data, 5–7 June 1999 (DIEG-1084, ICN-MHN-L-17183); 1 ♂, Quindío, Circasia, Vda. La Concha, Finca Membrillal, 2000 m, Int. del bosque, 21–23 April 1999, Diego Tobar (DIEG-513); 1 ♀, same data, borde del bosque, 23–25 July 1999 (ICN-MHN-L-17194); 1 ♂, same data, Vda. Membrillal, El Silencio, 8–10 June 1999 (DIEC 1160, ICN-MHN-L-17180), 1 ♂, Nariño, Ricaurte, La Planada, 1700 m, June 1999, F. G. Stiles (ICNL-11532); 1 ♂, Caldas, Samaná, Florencia, El Estadero, 1850 m, 15 June 1994, J. V. Rueda (ICNL-14038); 1 ♂, same data, 1950 m (17-NCP, ICNL 4154)[ICN].

Additional material examined (not included in type series): 1 ♂, Bogota, (Child), (genit. prep. ALV218-96), Rothschild Bequest, Brit. Mus. 39-1 [probably mislabelled] [BMNH]; 1 ♂, Prov. Cundinamarca, Monterredondo, 1420 m, 4 October 1956, J. Forster [ZSBS].

Life cycle. Eggs (Fig. 3a). Two eggs collected in the field measured 1.3 mm wide and 1.2 mm tall. Infertile eggs (n = 28) laid under laboratory conditions averaged 1.3 mm wide (SD = 0.02) and 1.2 mm tall (SD = 0.04). Solitary, rounded, creamy white, laid on new sprouts of *Chusquea* sp., whose leaves have not yet developed to full size. Usually on underside of leaves near the base, either close to the border or near the central vein. Micropile and surrounding area flat with numerous minute cells. Under 40× magnification a series of superficial sinuous meridians (formed by two lateral lines separated by a series of tiny cells) are alternated by a narrow area of small cells. The black epicranium of the larva is visible through the chorion two days before hatching. The two eggs collected hatched on 12 October 1999 and 24 March 2000, respectively. Although we still do not know the length of egg maturation, it can be estimated to last around ten days, as extrapolated from our experience with other species of *Pedaliodes* from the area, whose females were induced to lay eggs in the laboratory.

Table 1 presents the morphometrics of the larval stages of *P. zingara*.

First instar (Figs. 3b, 5a, b). Duration: 8 days (n = 2). Larval length 4.0 mm immediately after hatching. Larvae ate the chorion completely upon emergence. Epicranium: wider than body, bright black, with two prominent, apical, round scoli on vertex; epicranial cuticle with soft superficial reticulation both laterally and behind, except for scoli and area between them; epicranial setae greyish, sparse; the longest (0.3 mm) on scoli area; some lateral setae with tuberculate base. Body: creamy white, with lateral rows of very short, fine, subdorsal setae; another row of shorter and sparser setae on supraspiracular region (only visible at 40×, at least); longer and thicker, greyish setae on epicranium, prothorax and A10; those on subspiracular region translucent, long and thin, all visible at 10×.

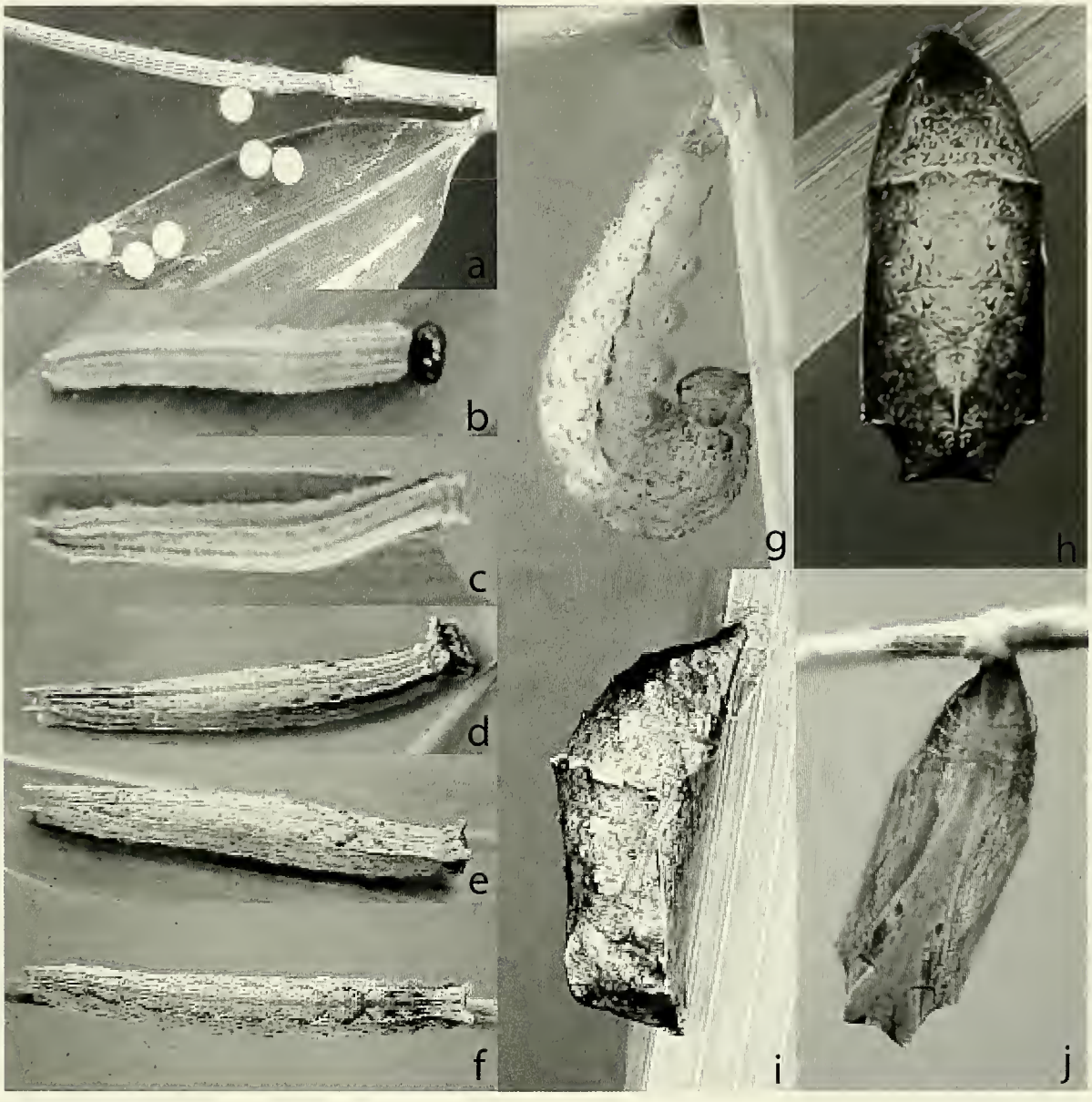

FIG. 3. Immature stages of *Pedaliodes zingara*, new species; **a,** Eggs; **b,** First instar; **c,** Second instar; **d,** Third instar; **e,** Fourth instar; **f,** Fifth instar; **g,** Prepupa lateral view; **h,** Pupa dorsal view; **i,** Pupa lateral view; **j,** Pupa ventral view (images are not proportional. Actual sizes in Table 1).

Upon development, larvae turn creamy-greenish with two creamy-white lines parallel to dorsal medium line, and two more lateral subdorsal lines running to segment A3; area between two central lines, and area above subdorsal lines turn light brown from A3 towards bifurcation of suranal plate. Legs and prolegs creamy-white.

Second instar (Figs. 3c, 5c). Duration: 7.8 days (n = 6; SD = 1.47). Exuviae totally consumed by larvae after molting. Larval length: 7.2 mm (n = 5, SD = 0.56). Epicranium with two scoli on vertex, brown, lighter behind scoli; dotted all over cuticle, tiny rounded concavities all over cuticle except for frontoclypeus, small region parallel to it, area between ommatidia, and mandibular region; concavities lightly darker than background; scoli covered by secondary setae with notably tuberculate bases; same kind of setae also occur sparsely laterally on posterior part of epicranium. Body: dorsal medium line brown, bordered with creamy-white lines, more visible on thorax and somewhat deviated on A5, disappearing beyond that; creamy-white subdorsal line on each side; brown between these and the medium one, turning lighter and variegated with brown to A6, and from extremity of A6 to dark brown bifurcation; dark brown band underneath subdorsal line, laterally and ventrally light greenish. Under great magnification (40×+) all body covered by tiny, light greenish chalazae, with secondary setae; spiracles light brown, connected along by a tenuous creamy-greenish line; ventral border ending in a creamy-white line.

Third instar (Figs. 3d, 5d). Duration: 7.5 days (n = 6; SD = 1.2). Larval length: 10.3 mm (n = 6; SD = 0.77). Epicranium: wider than body, with two scoli on vertex, brown tones alternate with dark brown producing a characteristic design (see Fig. 3d); dots and concavities pattern similar to previous instar; area without concavities creamy-white, only with light dots; two spots adjacent to superior

FIG. 4. Androconial patches on forewing dorsal of the holotype of *Pedaliodes zingara*.

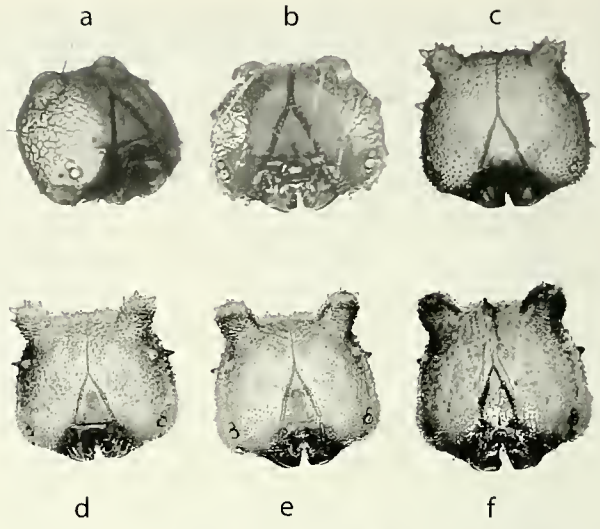

FIG. 5. Head capsule of *Pedaliodes zingara*: **a,** First instar lateral; **b,** The same frontal; **c,** Second instar frontal; **d,** Third instar frontal; **e,** Fourth instar frontal; **f,** Fifth instar frontal.

vertex of frontoclypeus, in frontal area; w-design in front of frontal portion of scoli, and lateral regions of epicranium dark brown; posterior portion of scolus area creamy-white, light brown between scoli. General aspect of body, light brown dorsally, creamy-greenish ventrally; at great magnification (40×+) entirely covered with chalazae of creamy-white color at base, and secondary, very short, light brown setae; a reddish-brown medium band, darkened from caudal extremity of segment A6 to segment A10; a creamy-white band running between central and subdorsal regions, including a light brown band from thorax to A1; the latter diffusing as dark brown dots, especially prominent at extremity of A1 and on A2; becoming a dark band again from caudal portion of A6 towards A10; another dark brown band on supraspiracular region, narrowing progressively towards last segments; spiracles brown; supraspiracular line creamy-white.

Fourth instar (Figs. 3e, 5e). Duration: 8.7 days (n = 6; SD = 1.4). Larval length: 15.9 mm (n = 6; SD = 1.57). Epicranium: slightly wider than body, with two scoli on vertex, same color pattern as previous instar; scoli with rounded surface, lacking prominent tuberculate bases; secondary setae more dense, longer around ommatidial and mandibular regions. Body color and design basically similar to those of third instar, but creamy-white subdorsal lines become caudally undulated; dark brown ^-shaped marks between these and medium dorsal brown line on segments A1 and A2, vanishing behind A2; some thoracic dark dots parallel to median line; a dark brown band laterally on thorax, underneath creamy-white line, vanishing at caudal extremity of body; spiracles brown; subspiracular line creamy-white.

Fifth instar (Figs. 3f, 5f). Duration: 14.2 days (n = 6; SD = 1.6). Larval length: 24.2 mm (n = 6; SD = 2.43). Epicranium: about same width as body, with two scoli on vertex, cuticle darker, but same pattern as fourth instar; frontoclypeus and mouthparts darkened; oral region almost black. Posterior portion of head (including backside of scoli) and prothorax, all creamy-white, lighter than rest of body, which is beige and sparsely marbled with greenish-brown. Body: dark greenish design on T2, T3, A1, and A2; a pair of dark green lines running along medium line of dorsum, more distinct on thorax; lateral narrow lines of creamy-white on subdorsal region of thorax, which becomes wavy and discontinuous in posterior segments thus conferring a dorsal design of rhomboidal, continuous figures, darker on A1, A2, and from extremity of A5 to A7; as a result of dense distribution of minute chalazae with diverse colors at their bases, and secondary short setae, body appears entirely marbled with greenish-brown and creamy-white; thorax laterally dark green; spiracles dark brown; subspiracular line creamy-white. Body ventrally sprinkled with brown; ventral border dark brown. Legs creamy-white, claws dark; prolegs creamy-white with a lateral dark brown spot.

Additional observations. Some individuals appear darker than others or with a sharper design on thorax and/or on both rhomboidal markings and marbling. While at rest, the larva brings down the epicranium to the substrate bending the body at segment T2. At the end of this instar almost all larvae pupated while fixing the cremaster to the underside of *Chusquea* leaves. We were unable to locate pupae in the field, probably due to their highly cryptic appearance when attached to dark stems, which might be their natural substrate as observed in other *Pedaliodes* species (unpubl.). Prepupa stage (Fig. 3g) lasted three days for all individuals we studied; the larvae then lost their ordinary color pattern and became entirely beige. Average length of prepupae was 38.5 mm.

Pupa (Figs. 3h–j). Duration: 22.5 days (n = 6; SD = 2.9). Length: 17.6 mm (n = 6; SD = 0.53); width: 6.9 mm (n = 6; SD = 0.27). In dorsal view the general aspect of the pupa is that of a small lantern, having a more or less cylindrical shape from T1 to A3, and a conical one from A10 to the shelf projected at A3, which ends in a dentate edge. Background color brown with profuse darker dotting and markings; cephalic portion ends in two angles separated 3.3 mm from each other (n = 6, SD = 0.2); basal area of wings also ends in two angles separated 6.4 mm from each other (n = 6; SD = 0.22); rows of minute protuberances (resembling pin heads) on both sides of medium line, from A1 to A6, being reddish-brown on A4, A5, A6 and marked with black on A1, and A2; dorsally darkened by grayish marbling in central area between two rows of protuberances; broadened portion between segments A4 and A5 where cuticle is thinner and smooth; margin of cornice at A3, inner margin of wing, and a triangle formed between epicranium and margin of keel at T2, all darker brown, bright reddish-brown in some individuals. Ventrally wing region with brown patches, slightly darker in costal region, with some sparse dots on external margin of wing. Mesothoracic legs with two brown patches, the first one longer, entering the prothoracic legs. Antenna carved with light brown dots. Laterally, two grayish bands from cremaster to wing outer margin, running behind spira-

TABLE 1. Morphometrics of larval stages of *Pedaliodes zingara*, new species. All measurements in milimeters, standard deviation in parenthesis.

	1st instar	2nd instar	3rd instar	4th instar	5th instar
Epicranium	n = 6	n = 5	n = 6	n = 6	n = 5
Width	0.99 (0.03)	1.34 (0.04)	1.83 (0.05)	2.63 (0.10)	3.76 (0.11)
Height	0.87 (0.05)	1.20 (0.03)	1.67 (0.07)	2.42 (0.09)	3.44 (0.16)
Scoli	n = 6	n = 5	n = 6	n = 6	n = 5
Inner separation	0.29 (0.01)	0.45 (0.05)	0.55 (0.03)	0.85 (0.04)	1.31 (0.08)
Width	0.22 (0.02)	0.30 (0.00)	0.41 (0.02)	0.60 (0.05)	0.90 (0.12)
Height	0.10 (0.00)	0.29 (0.02)	0.48 (0.02)	0.61 (0.04)	0.88 (0.02)
Suranal plate	–	n = 3	n = 4	n = 4	n = 2
Bifurcation length	–	0.25 (0.05)	0.55 (0.12)	0.78 (0.14)	1.00 (0.00)
Tip separation	–	0.51 (0.02)	0.80 (0.08)	1.26 (0.09)	1.80 (0.00)

cles; the latter bordered with dark brown. Cremaster as long as wide, hooks brown, and silk light brown; pad always appearing as a brown patch.

Development time. At 20°–24° the development of *Pedaliodes zingara* from egg hatching to imago emergence has taken 68.7 days on average. Considering that the egg might last around ten days (as speculated above) the entire life cycle of the species should complete in nearly 79 days.

Etymology. In naming this species after Finca Zíngara, a farm property of the Gensini family, we recognize the relevance of that area for recent studies on biodiversity and conservation of Colombian cloud forests. *Zíngara* is also one of the Spanish words for Gypsy.

Remarks. In natural conditions *Pedaliodes zingara* lays solitary eggs on the underside of fresh leaves of one or two possibly undescribed species of *Chusquea* (L. Clark, pers. com.). This habit has already been recorded for several species of the genus, and also in other pronophiline butterflies (DeVries 1987).

One adult female of *P. zingara* bred entirely in the laboratory started ovipositing on *Chusquea* leaves eight days after emergence, laying a total of 64 infertile eggs (minimum 2, maximum 24 eggs/day). This individual was also dissected after its death. We found 40 chorioned eggs plus 80 developing eggs, half of the latter were in advanced vitelogenic stage. Thus, it yielded a reproductive potential of 184 oocytes. During the dissection it was noted that the fat body surrounding the ovarioles was scarce.

More than half of the fertile eggs of all *Pedaliodes* species found in the field were parasitized.

DISCUSSION

Early stage biology. *Pedaliodes* is one of the most diverse genera of butterflies (270+ spp., according to Viloria 2002). However, it is remarkable that to date only parts of the life cycles of three species are known: *Pedaliodes phoenissa* (Hewitson) in Colombia (Schultze 1930), *P. cremera* Godman & Salvin; (DeVries 1987) and *P. dejecta* (Bates) (DeVries 1987). Other early stage records for '*Pedaliodes*' species refer to taxa lately transferred to other genera (Forster 1964, Adams 1986). Müller (1886) wrote a very detailed description of the fifth instar and the pupa of *Praepedaliodes phanias* (Hewitson) from Brazil, DeVries (1987) identified the foodplant and provided the description of the egg of *Praepronophila perperna* (Hewitson) in Costa Rica, and Pelz (1997) described the full life cycle of *Parapedaliodes parepa* (Hewitson) bred from Ecuadorian eggs on a supplementary European host.

The eggs of *P. zingara* are similar to those described by Schultze (1930) for *P. phoenissa* and those of *Parapedaliodes parepa* (Pelz 1997). They all show "fine and regular reticulation." Studies with higher magnification might reveal unique structures for each taxon (see Sourakov 1996).

Females of *P. zingara*, like those of *P. manis*, *P. poesia*, and *P. peucestas* (MDH unpubl.) emerge with eggs undeveloped, vitelogenic, and, mostly, previtelogenic.

From observation and dissection of infertile females fed at the laboratory and of fertile, fresh females brought from the field, we have a first idea of the pattern of production of eggs in these species. Their age-fecundity graphs (MDH unpubl.) recall pattern 'C' illustrated by Boggs (1997: Fig. 1). The potential of these species is about 200 eggs, and during peak fertility the daily production fluctuated around 20 eggs. Under lab conditions these species last 4–8 days before they mature and start ovipositing. Other Satyrinae grown under similar conditions never matured their eggs, possibly because, besides food, they need to be stimulated by copulation (Ehrlich & Ehrlich 1978, MDH unpubl.).

Pedaliodes zingara feeds on at least two species of *Chusquea* (sections *Chusquea* and *Longiprophyllae*, respectively) that occur in the study area, which suggests that in this case there is no strict host specificity, a common feature observed in butterfly larvae that feed on Poaceae (Singer & Ehrlich 1991, Sourakov 1996, Pelz 1997).

During daytime satyrine larvae are generally cryptic in behavior and appearance; for instance, first instar

individuals of *P. zingara* remained mainly resting beneath the apex of the bamboo leaves, moving only when they started to eat at the leaf edges. From second instar onwards, they spent most of the time over the brown or brownish stems, preferably feeding on the leaf bases. Thus, the aspect and position of the larvae is cryptic, assuring protection against potential visually-hunting predators. Other possible defense mechanisms in these insects are unknown. All *Pedaliodes* larvae we know have a ventral, prothoracic, neck gland of creamy-white color, but they did not release any detectable odor or substance during manipulation and handling.

Most of the morphological features of the head and body cuticle of *P. zingara* larvae are superficially shared by *P. phoenissa* and *P. parepa*. If there were better descriptions of the coloration and reticulation design of the epicranium of these species, then significant differences between them could be established (Sourakov 1996, and pers. obs.). Each species shows a unique pattern of larval coloration, particularly on the fifth instar. The shape of the pupa of *P. zingara* is not unlike that of *Parapedaliodes parepa*. Schultze (1930) does not provide enough details of this stage to compare with *P. zingara*, but in our experience the pupae of different *Pedaliodes* species may differ much in shape and coloration from each other.

The duration of the life cycle of *P. zingara* was shorter than that of *P. phoenissa* and *P. parepa*. Major differences were observed in the fifth instar of *P. parepa* (30 days) and the pupa stage of *P. phoenissa* (37 days). This is possibly due to the fact that the last two species live naturally in colder zones (altitudes between 2500 and 3000 m), as it is generally accepted that higher temperature results in faster development of larvae (Knapp & Casey 1986).

Systematic relationships. Most of the major works on the genus *Pedaliodes* (Thieme 1905, Forster 1964, d'Abrera 1988) and other studies dealing with Colombian taxa (Bayern 1902, Fassl 1910, 1911, 1915, 1918, Krüger 1924, Adams 1986, Pyrcz 1999, Pyrcz & Viloria 1999), either did not consider this taxon or misidentified it as *P. phrasiclea* (see synonymy above).

Comparing wing shape and color pattern, androconial systems, male genitalic structure, and geographical distributions, we conclude that *Pedaliodes zingara* is another member of the '*pisonia*-group' (see discussion in Viloria & Pyrcz 2000: 39–40, and Viloria et al. 2001), a possibly monophyletic cluster of 'lowland' species within the genus. It is morphologically intermediate between the Venezuelan *P. pisonia* and *P. phrasiclea*, which apparently ranges from southern Colombia to Bolivia.

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